- Annual maintenance costs are expected to be $10,000 for the turbine specified in this report.
- Summary of annual maintenance and repair downtime:
    i. Assume one week each year,
    ii. Assume three weeks every five years,
    iii. Three months every 25 years

3.3 Hydroelectic power generation

Potential, or theoretical, hydroelectric power generation is a function of flow and net head, regardless of the technology used for generation. Expected hydroelectric power generation is a summation of kilowatt-hours (kWh) theoretically generated by the turbine-generator technology for this given flow and head dataset and the water-to-wire efficiency of the unit(s). Losses include the turbine, generator, friction losses at the hydroelectric plant, as well as site electrical and transformer losses. For this project, we contacted Canyon Hydro Industries in Deming, Washington. Canyon Hydro is a reputable hydroelectric turbine manufacturer that specializes in Pelton turbines and associated equipment with numerous successful installations throughout the US and the world. Based on the various head and flow scenarios for each site, Canyon Hydro determined that a horizontal, single-nozzle Pelton turbine is the most efficient turbine for the expected hydraulic conditions for either site.[1] Appendix 1 provides an overview of the turbine specifications. Table 2 provides an overview of the expected water-to-wire of the hydroelectric station.

Table 2: Hydroelectric Plant Efficiency

MCSD Intake Spring - Hydroelectric Plant Efficiency	
	Pelton
Turbine Peak Efficiency	82.7%
Generator Efficiency	95.0%
Combined Efficiency	78.6%
Other Hydraulic & Electrical Losses	2.00%
Water-to-Wire Efficiency	**76.6%**

[1] Additional years of data should be reviewed in order to determine a full range of flows and associated pressures that the proposed turbine could encounter. Providing a multi-nozzle turbine may offer additional generation potential and should be analyzed in the design portion of the project development.

Table 3 summarizes the flow and head ranges, power capacity, net efficiency, expected annual generation, full equipment package cost and ability of the turbine to process future flows.

Table 3: Turbine Technology Summary

MCSD Intake Spring - Turbine Technology Summary		
	Site 1 (PRV)	Site 2 (1 MG Pond)
Turbine Classification	Impulse	Impulse
Turbine Technology	Pelton	Pelton
Rated Flow	4 - 7 cfs	4 - 7 cfs
Maximum Flow	7.5 cfs	7.5 cfs
Minimum Flow	0.7 cfs	0.7 cfs
Rated Head	805 - 950 ft	915 -1080 ft
Turbine Rating	390 kW	445 kW
Water-to-Wire Net Efficiency	76.6%	76.6%
Annual Generation	2,509,000 kWh	2,924,000 kWh
Water-to-Wire Package Cost	$380,000	$412,000

Using NLine Energy's proprietary models in conjunction with turbine efficiency curves provided by the turbine manufacturer, 2011 and 2012 flow and pressure data were used to replicate expected generation output for each site. Table 4 summarizes this analysis.

Table 4: Expected Annual Generation

MCSD Intake Spring - Expected Annual Generation			
	2011	2012	Average
Site 1 Generation (kWH)	2,450,000	2,568,000	2,509,000
Site 2 Generation (kWH)	2,928,000	2,920,000	2,924,000

3.4 PacifiCorp tariff pricing options

Pacific Power, through their parent company PacifiCorp, offers multiple pricing options for renewable power generators. For this report, revenue analysis was conducted using the Firm Avoided Cost Prices forecast,[2] for a start year of 2016. A "start year" refers to the year that the hydroelectric generator would deliver power to the grid. References to "Qualifying Facility" or "QF" refer to the customer providing generation. [1]

3.4.1 Pricing options[3]

3.4.1.1 Fixed Avoided Cost Prices

Prices are fixed at the time that the contract is signed by both the customer and PacifiCorp. Fixed Avoided Cost Prices are available for a contract term of up to 15 years and prices under a long-term contract (up to 20 years) will thereafter be under the Firm Market Indexed, the Banded Gas Market Indexed or the Gas Market Indexed Avoided Cost pricing option. Under this option, the District would receive the $-kWh price by delivery period (on-peak or off-peak) for each delivery year from 2016-2030. Note there is annual price change from year-to-year, but the table shows the currently available prices. After 2030, pricing is expected to increase the 15-year average of 2.6% annually. Table 5 illustrates PacifiCorp's Fixed Avoided Cost Prices.

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[2] PacifiCorp Schedule 37 - Avoided Cost Purchase from Qualifying Facilities of 10,000 kW or Less.

[3] While the prices, and options, found in this report are current as of January 2014, PacifiCorp has an application before the Oregon Public Utilities Commission (UM1610) to make changes in its QF contracting and pricing. This proceeding should be decided in 2014, at which time new contracts and pricing will become available. We recommend updating the revenue analysis during the design phase of the project to obtain the most current contract pricing information.

Table 5: PacifiCorp's Fixed Avoided Cost Prices - 2012-2030 (¢-kWh)

Deliveries During Calendar Year	On-Peak Energy Price	Off-Peak Energy Price
	(a)	(b)
2012	3.09	2.32
2013	3.72	2.62
2014	4.13	2.80
2015	4.39	2.99
2016	6.04	3.69
2017	6.32	3.91
2018	6.66	4.21
2019	6.99	4.50
2020	6.94	4.41
2021	7.23	4.65
2022	7.67	5.04
2023	7.92	5.24
2024	7.89	5.16
2025	8.09	5.32
2026	8.39	5.57
2027	8.66	5.78
2028	8.88	5.95
2029	9.07	6.09
2030	9.20	6.16

Based on this pricing model, we modeled expected generation by delivery period and year for both 2011 and 2012. Table 6 depicts expected annual revenue for each year using 2016 QF contract pricing.

Table 6: Intake Spring Expected Annual Revenue

MCSD Intake Spring - Expected Annual Revenue			
	2011	2012	Average
Site 1 Revenue	$ 120,000	$ 126,000	$ 123,000
Site 2 Revenue	$ 144,000	$ 143,000	$ 143,500

McCloud Community Service District
Intake Spring Hydroelectric Project

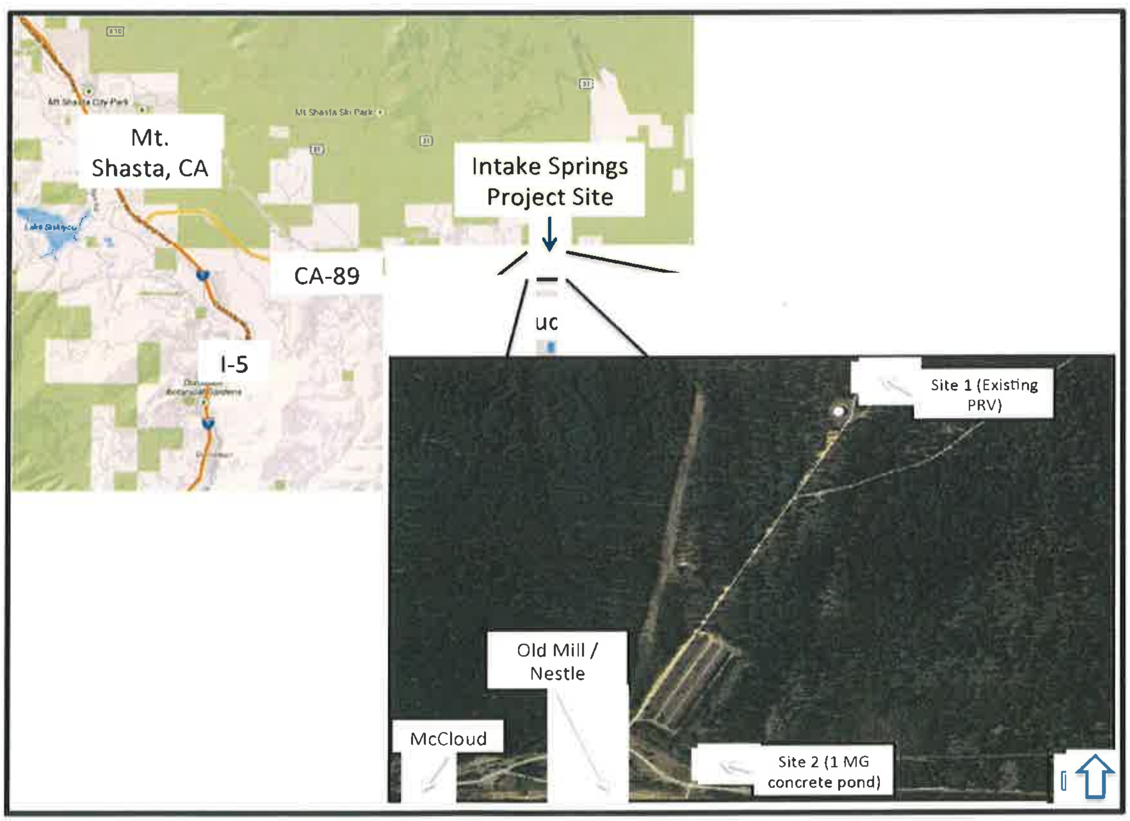
Background

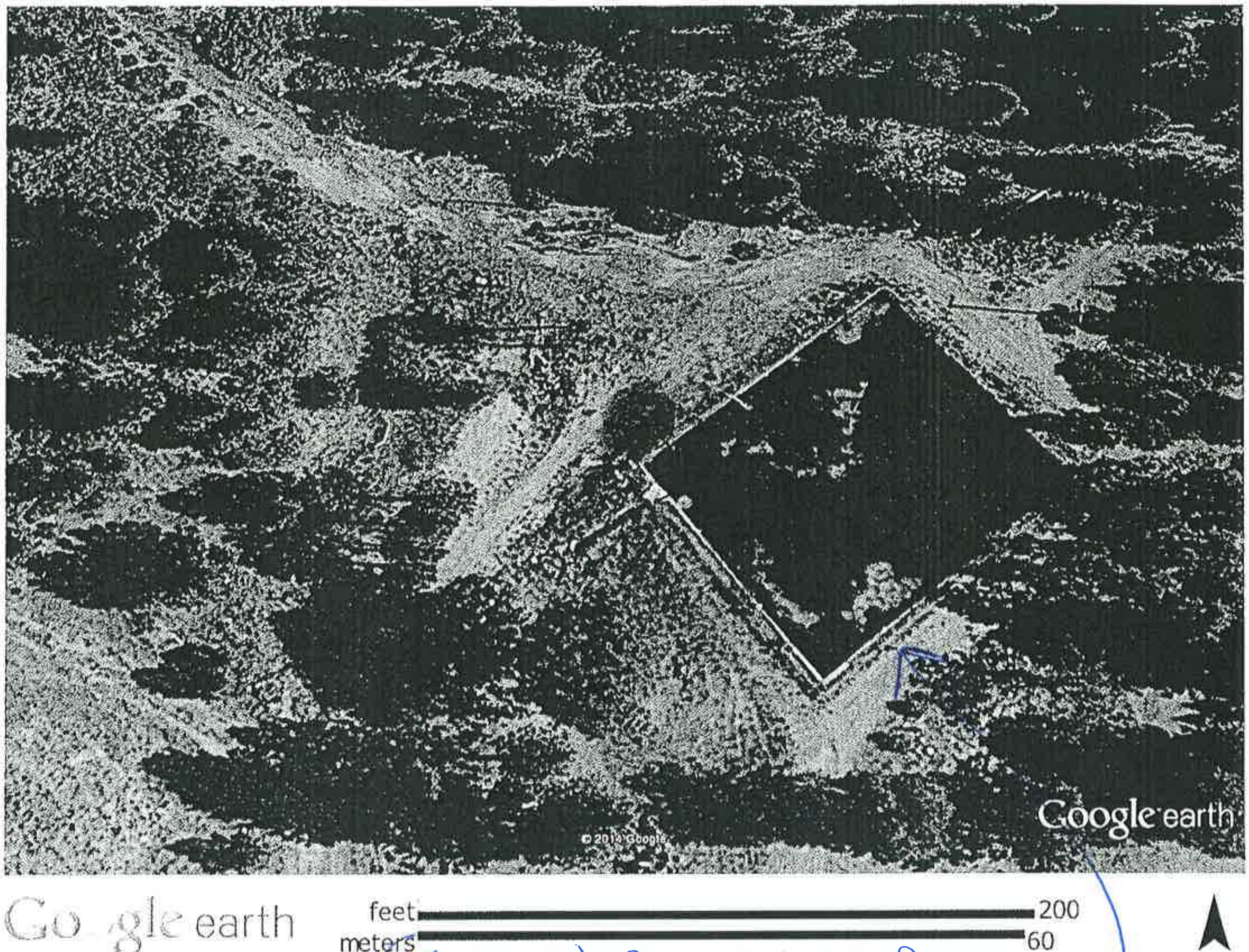
The McCloud Community Services District (MCSD) was formed in 1965 to provide the community of McCloud, California with municipal services including water and sewer management, alley maintenance, refuse collection, park and recreation management, fire and ambulance services, and library management. MCSD operates the water supply for the town of McCloud, CA. The District is served by three water sources originating from the base of Mt. Shasta: Intake Spring, Upper Elk Spring and Lower Elk Spring. MCSD is located at 220 W. Minnesota Avenue, McCloud CA 96057.

Project Description

A newly constructed, 14-inch ductile iron pipe transmits water from Intake Spring head works to a pressure relief and metering station located to the north of two tanks - - a new, covered 1.2 million gallon (MG) tank and a 1 MG uncovered tank. The Elk Spring pipeline also feeds the tanks. Flows to the tank site are either routed to the town for consumption or spilled into Squaw Creek, located immediately to the east of the tanks. Water from the three water sources is considered potable and needs no pretreatment. Two potential project sites were evaluated. Site 1 is located at the existing pressure relief structure approximately 380 ft north of the 1.2 MG storage tank. Site 2 is located adjacent to the 1 MG concrete pond, located north of the Old Mill / Nestle property Based on the head, flow and an analysis of turbine costs relative to the potential revenue generated, NLine Energy determined that a Pelton turbine is the most applicable technology.

Figure 1: Site overview





(1 MG) CONCRETE POND

41°16'0" N 122°07'15" W ELEV. 3420 ft

Hydro Elec. Power Site #2

SCE

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McCloud Community Services District

THE HYDRO SYSTEM IS EXPECTED TO PRODUCE ABOUT 3,000,000 KWH PER YEAR.

THIS IS EQUIVALENT TO : 2,117 METIC TONS OF CARBON DIOXIDE

: 441 CARS DRIVING

: 291 HOMES ELECTRICITY USE FOR THE YEAR.